

MABEL L1A Release 008

Standard Data Product

Version 1.0, 10/24/2012

David W. Hancock III, Jeffrey E Lee

Introduction

Release 008 MABEL L1A products are created by Version 1.6 of the MABEL processing software.

This release note focuses on changes specific to the MABEL L1A products. Please see the **MABEL Release 008 Software Change and Release Note** (located in the MABEL Repository) for information regarding changes/improvements to the Release 008 L1A software.

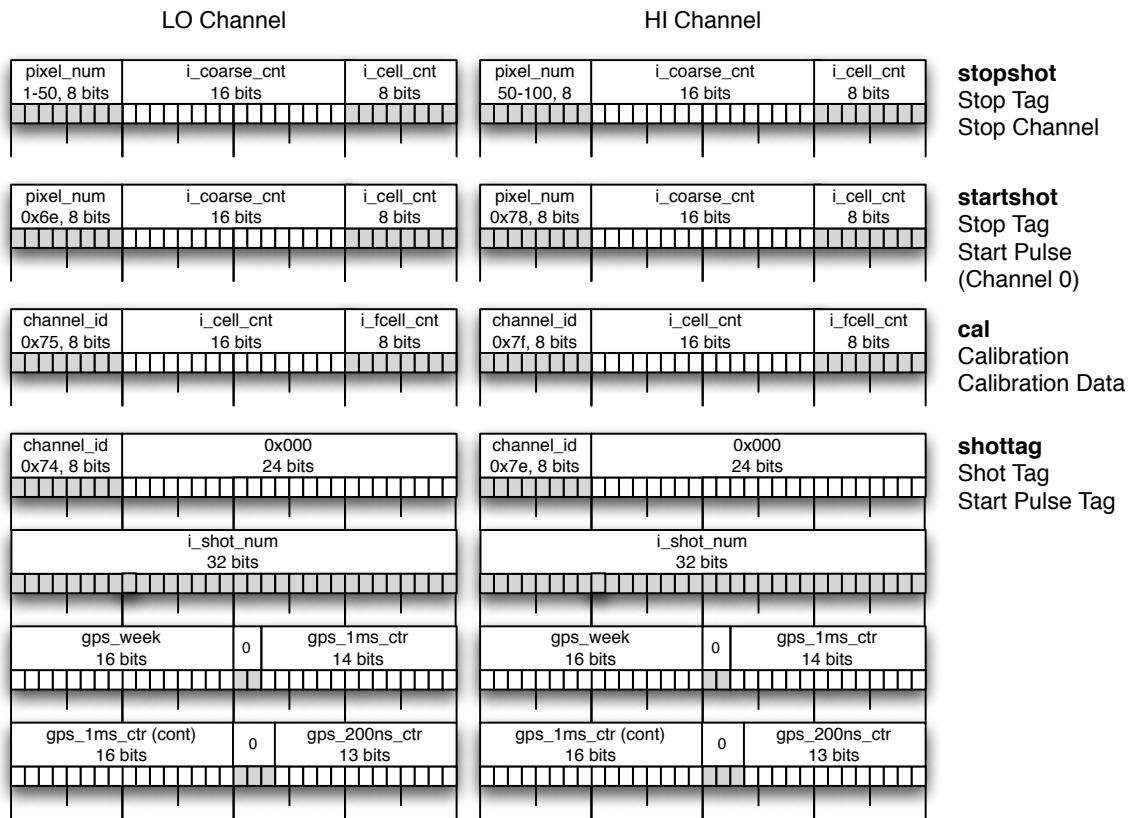
The format of the Release 008 L1A Products has changed from Release 007. For this reason, the "l1a_format_version" global attribute has been updated to "1.3".

There are changes to the structure and content of the L1A product. The major changes include:

- Metadata has been totally revamped to include ECS-style structured metadata as well as enhanced CF-style global attributes. Product users are encouraged to use the CF-style global attributes whenever possible since the ECS-style metadata will be replaced by ISO19115-style metadata in a future release. The relevant attributes within the structured metadata are duplicated in the global attributes.
- The "flight_parameters" group is now HDF5 attribute-based (as opposed to dataset-based).
- Most attributes are now lower case and (in many cases) include a corresponding description (_desc).
- The L1B HDF5 products should be readable with NetCDF software.
- Dimension scales (DS*) have been added to improve NetCDF compatibility. Dimension scales define array dimensions in terms of a physical measurement. Dimension scale datasets begin with "DS".
- The "ancillary_data" group was created to span the gap between metadata and science parameters. This group is attribute-based, may contain subgroups, and contains such information as MABEL constants, temporal span of the granule, geographical span of the granule, and various parameters used during generation of the product.
- The granule epoch (gps_sec_offset) is now an attribute attached to "ancillary_data".
- The "quality_assessment" group has been reorganized to use arrays instead of single datasets for multi-statistic parameters (ie: counters, min/mean/max/stdev). A dimension scale (DS_packet_counts, DS_statistics) is provided to identify each array dimension.

Input Products

MABEL TOF data, Housekeeping, and Status files are the input products for the L1A processing. The figure below displays the physical layout of the input MABEL TOF data files and identifies the names of parameters used in the processing description and output HDF5 file.



Repository

The MABEL data, documentation and example code are available at the following URL:

http://icesat.gsfc.nasa.gov/icesat2/data/mabel/mabel_docs.php

Access Constraints

The following access constraint statement was approved by the ICESat-2 Project Office and included in the Metadata of each product file:

"Data may not be reproduced or distributed without including the CitationForExternalPublication for this product included in this Metadata. Data may not be distributed in an altered form without the written permission of the ICESat-2 Science Project Office"

MABEL L1A Data Usage

MABEL L1A HDF5 files contain all of the data types provided in the L0 TOF files, metadata extracted from the day-by-day flight log and QA (Quality Assurance) statistics for some of the parameters. These data are organized with HDF Groups. A product data description follows later in this document. Raw Range has been computed from the laser Tx times and the times of the received photons. These ranges have no corrections applied.

This product is considered raw data and of limited use to the general public. The product basically takes care of a number of processing details to make a clean set of raw events and ranges. The most important user output is the file summary information that reports the number of shots and received photons and the number of these that could not be used. Events are not used if they are declared to be duplicates or do not properly have all the information to make a range

computation. Summary stats like average number of received photons for each shot for a time period (currently 10 seconds) for each channel are provided. The Metadata contains the mapping of the channels to their beam.

The L1A Release 008 data product is appropriate to use for learning how to access data from an HDF5 file and to provide the development team comments on missing items, ways to improve the groupings, and improving the descriptions. The geolocated data have a different grouping and any user of MABEL data will likely desire to have the location and calibrated elevations that are present on the L2A product. This product is also an initial prototype of ICESat-2 data and comments are welcome.

MABEL L1A Data Notes

Version 8 products have the following notes/caveats:

1. Data from the raw instrument files were dropped if they did not have a Time of Day the current s/w could not compute. The noted events for this are if the TX start time was missing or GPS “failed”. There is an issue one flight where GPS stopped providing information to the TOF card.
2. Duplicate TX and received photon events are dropped and not recorded on the L1A. For mission 2 Duplicates are about 12% of the data
3. MABEL data files are HUGE, but the HDF5 files are slightly smaller than the original TOF files. There may be more efficient HDF5 “chunking” that will improve the data sizing further. This will be tested later. One 5 minute file was 4 Gbytes (the raw data was 5 Gbytes).

File Naming/Versioning

The MABEL H5 file naming convention is as follows:

```
mabel_LLL_YYMMDDTHHMMSS_RRR_V.h5
```

Where:

LLL=level of product (ie: l1a, l1b)

YYMMDD=year month day of requested granule start time

HHMMSS=hours minutes seconds of requested granule start time

RRR=Release number (further explained below)

V=Version number (further explained below)

Example:

```
mabel_l1a_20101211T004500_008_1.h5
```

The MABEL product versioning scheme uses Release and Version numbers. The Release is an instance of the MABEL product corresponding to a specific version of the MABEL processing software. (For example, the Release 008 MABEL L1A products were created by the V1.5 MABEL processing software.) The version field specifies the instance of the Release processed/reprocessed by the same version of software.

Example Code

Example IDL and Fortran code is provided at the MABEL repository.

L1A Product Data Description

The HDF5 file is hierarchically structured with groups for Metadata, Ancillary Data, Quality_Assessment, Flight_Parameters, Range, Housekeeping, and TOF data. There may be one or two TOF groups, depending on how the instrument was configured. Each TOF group contains Header, Cal, Startshot, Stopshot, Shottag, and Status values. The TOF/Shottag and Range groups are further sub-divided by channel number.

Data rates of individual groups differ, so the a delta time (time since the start of the file) is stored within each group to enable time-alignment of data within different groups. Storing different-rate data within separate groups allows us to avoid the issue of fill data and saves significant amounts of storage space (a real issue with large data sets such as this).

For each data Group, parameters are stored in individual HDF5 datasets. The reason for this is that using separate datasets allow us to attach parameter-level metadata attributes to each parameter. If the parameters were stored in the same dataset, it would be more difficult to attach the metadata attributes.

For each informational Group (Metadata, Ancillary Data), parameters are stored as group-attached attributes. The HDFGroup recommended the use of attributes since they are more appropriate for informational data.

The HDF5 file is configured for HDF5 chunking and internal gzip compression. Using the rate-separated data layout and internal gzip compression has enabled us to minimize the size impact of converting the L0 TOF data to HDF5. In fact, for a sample file, the L0 TOF file is 13MB. The corresponding HDF5 file is only 10MB. This is almost a 30% saving in storage space and especially significant since the HDF5 file has derived parameters, repeated delta_time and metadata in addition to all of the original L0 data.

Data Groups

The HDF5 groups are as follows (derived from h5ls -r file | grep Group). METADATA subgroups have been edited for brevity.

```
/ Group
/METADATA Group
/METADATA/COLLECTIONMETADATA Group
/METADATA/INVENTORYMETADATA Group
/ancillary_data Group
/ancillary_data/general Group
/flight_parameters Group
/housekeeping Group
/quality_assessment Group
/quality_assessment/along_track Group
/quality_assessment/packet_counts Group
/quality_assessment/summary Group
/range Group
/range/channelxxx Group
/tof1 Group
/tof1/cal Group
/tof1/header Group
/tof1/shottag Group
/tof1/startshot Group
/tof1/status Group
/tof1/stopshot Group
/tof1/stopshot/channelxxx Group
/tof1/wedge0 Group
/tof1/wedge1 Group
```

The cal, header, shottag, startshot, stopshot, status, and housekeeping groups contain the entirety of the L0 data. The metadata, flight_parameters, quality_assessment, and range groups contain metadata. flight parameters, quality assessment, and raw derived range parameters, respectively. Within the range and stopshot groups, there are subgroups (Channelxx) for each channel of data detected within the L0 data. Respective TOF groups are only present if the requisite input TOF1/TOF2 files are present.

Parameter-Level Metadata

The following attributes are attached and filled for each parameter. Some of these attributes may seem redundant but are present for future NetCDF/CF convention compliance.

Name	Description
Coordinates	Field to be used on x-axis for plotting. (Placeholder for future NetCDF/CF compliance.)
Datatype	The HDF5 data type
Description	Description of data parameter
Hertz	Nominal data rate of parameter
Label	HDF5 label identifying the data element.
Long_name	Descriptive name (useful for plot labels)
Name	Name of data parameter
Rank	Number of array indices (one-dimensional array=rank 1, two-dimensions=rank 2)
Source	Source of data parameter. Includes computational details, if appropriate.
Standard_name	CF-compliant standard name
Units	Physical units of data

Granule-Level Metadata

Granule-level metadata is a mixture of ECHO-style structured metadata and CF-style global attributes. The structured metadata is more complete and computer-friendly; the global attributes are simpler and more human-friendly. Data users are encouraged to use global attributes whenever possible since the structured metadata will be replaced by ISO19115 equivalents in a future release.